that perhaps the resistance to development with which they meet in the more completely formed tissues may account for the diffuse character of their axis-cylinder prolongations. One interesting deduction from the laws of growth can be applied to the completed nervous system. Since the nerve-cells and fibres start from fixed points, those that appear first in development will be more or less overgrown and covered by those which appear later. This is illustrated by the relations of the nuclei of the *hypoglossus*, lateral column, the ascending root of the *glosso-pharyngeus* and *vagus*, etc., in a cross-section of the *medulla*. No one can read this paper of His without assenting to his final statement that embryology stands foremost among the means which we have at our command for unraveling the organization of the central nervous system.

Zur feineren Anatomie des centralen Nerven-systems. Erster Beitrag. Das Kleinhirn. A. KÖLLIKER. Zeitschrift f. Wissen. Zool., B. 49, H. 1. Mai, 1890. Taf. XXX—XXXIII.

Under this title Kölliker has reviewed the results obtained by Golgi, Ramon y Cajal, and himself, laying of course the principal emphasis on the method of silver impregnation introduced by Golgi. The lower mammals, cat, dog, etc., are largely used in these studies, and it is not always clear how far the several points have been made out for man, but I will endeavor to give a description of the elements in the human cerebellar cortex as they are now regarded by Kölliker.

The *Molecular Layer:* The cells of Purkinje are somewhat flattened and their enormously developed protoplasmic prolongations lie in a plane at right angles to the long axis of the cerebellar folia. These prolongations end free. The axis-cylinder prolongation gives off lateral branches, some of which at least turn back towards the molecular layer, while the main stem passes on to become a medullated fibre. The small cells of the Molecular Layer: (*a*) The peripheral small cells lie in the outer half of the molecular layer and have well-developed protoplasmic prolongations. The axis-cylinder prolongation is present, but its character and distribution have not been determined. (*b*) The central small cells belong to the most remarkable elements yet described for the nervous system, and from the peculiar terminations of the axis-cylinder prolongations have been termed "basket-cells." They lie just ectad of the bodies of Purkinje's cells, are more numerous where these latter are more abundant, have their long axis in the plane of the cortical surface, and give rise to numerous and complicated protoplasmic prolongations, some of which may run almost to the surface of the cortex. The axis-cylinder prolongation is very long, runs in the plane of the surface, just above the bodies of the cells of Purkinje and in the neighborhood of each cell sends down a branch, which dividing into a bunch of terminals forms a net or "basket" about the cells. Of this very remarkable arrangement Kölliker expresses himself as perfectly satisfied.

This exhausts the classes of nerve-cells in the molecular layer, and we pass next to the *Granular Layer*. There are here distinguished large and small nerve-cells. (*a*) Large nerve-cells: These are characterized by being few in number, situated just below the molecular layer, having their protoplasmic prolongations distributed in both molecular and granular layers, and having the axis-cylinder prolongations of the second type, which have thus far been found, distributed in the granular layer alone. (*b*) Far more numerous than the foregoing are the small nerve-cells of this layer. These are furnished with short protoplasmic processes which end in bunches of terminals, suggesting in a distant way the terminations of the axis-cylinder branches in the "basket cells." The axis-cylinder prolongations on the other hand are slender,

long, arise as a rule from a protoplasmic prolongation at their base and pass without exception to the molecular layer, within which they divide into two branches running longitudinally and parallel to the surface; so abundant are these T-terminations in this region that a longitudinal vertical section of a folium shows a distinct longitudinal striation due to them.

Turning now to the *Nerve Fibres:* (*a*) The medullated fibres form a thick net-work in the granular layer, a thick band just below the cells of Purkinje, and bundles passing to the molecular layer between these cells. In the molecular layer they are abundant in the central portions and decrease towards the periphery. In this layer also they sometimes divide. (*b*) A portion of the fibres from the medullary layer are non-medullated, and end in part in the granular and in part in the molecular layer, and owing to the fewness of them in the latter locality they may be associated with the small peripheral nerve-cells of that region.

If the matter is looked at from the other side and we attempt to account for the nerve prolongations of the several groups of cells just described, we have the following:

Molecular Layer.—Cells of Purkinje, nerve prolongations medullated; (*a*) small peripheral cells, nerve prolongations not known; (*b*) basket-cells, nerve prolongations non-medullated. *Granular Layer.*—(*a*) Large nerve-cells, nerve prolongations non-medullated; (*b*) small nerve-cells, nerve prolongations medullated, giving rise to the bundles of nerve-fibres which pass between the cells of Purkinje and finally form the longitudinal striation of the molecular layer mentioned above(?) Nowhere is there seen anastomosis between the termini of cells or fibres either with themselves or with one-another, and the physiological relation remains therefore as much of a riddle as ever.

Zur feineren Anatomie des centralen Nerven-systems. Zweite Beitrag. Das Rücken-Mark. Taf. I—VI. A. KÖLLIKER. Zeitschr. f. Wissen. Zool., 51 Band, 1 Heft. Dec., 1890.

In this second communication Kölliker has formulated the new facts concerning the spinal cord much in the same manner as he has those for the cerebellum in the first communication just reviewed. The discoveries are the result of the application of Golgi's method to the nervous system of fœtuses or very young animals and the chief authorities, as before, are Golgi and Ramon y Cajal. In the material from immature animals the nerve-fibres are non-medullated to a greater or less extent, and appear therefore to be more easily brought out by the silver method. The fact that many of the results thus far obtained have not been verified on the adult by this same method may be urged against the validity of the conclusion, but other methods used on the adult give so much confirmation to the results here described that there is great reason for considering them as generally true.

In the light of these investigations the spinal cord in man may be described as follows:

The *dorsal nerve roots* all arise from the spinal ganglia, enter the dorsal column of the same side and there sooner or later divide into two branches one of which runs cephalad, the other caudad. In some cases these longitudinally coursing fibres run for a distance in the fœtus which would be equivalent to 4—6 cm. in the adult. In other cases they soon bend at right angles to the long axis and run into the gray matter, where they terminate. The criterion of termination is the formation of one or more finest branches, which in certain cases may amount to a bunch of terminals suggesting the "baskets of the baskets cells" in the cerebellum. In addition to these terminals there are those of an entirely new sort, formed by so-called "collateral fibres." These are very fine, arise more or less at right angles to the course of the main fibre, and appear too,